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Examiners' Report
January 2013

GCE Chemistry 6CH08 01

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January 2013

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Introduction

To score high marks on this paper candidates need to be familiar with standard practical techniques. Questions focus on observations, measurement and the logical deduction of valid conclusions from data. In general candidates scored very well on questions involving routine techniques, observations and calculations, but found it more difficult to apply their knowledge to unfamiliar situations and to explain the rationale behind some standard techniques.

Question 1

This question was generally well answered. Candidates found parts (b) and (c) most difficult. In part (b) few could identify the correct reaction type and in part (c) few realised that the sodium hydroxide was acting as a base.

A good answer with just one error.

(b)	Measure the pH of a dilute aqueous solution of **A** using a pH meter.	The pH is 6.0.	The type of reaction that has occurred when **A** dissolved in water is acid - base.	(1)
(c)	Add a few drops of dilute sodium hydroxide solution to a solution of **A**.	A green precipitate forms.	The sodium hydroxide is acting as a ligand The **formula** of the green precipitate is $[Fe(H_2O)_4(OH)_2]$	(2)

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Examiner Comments

Part (b): Transition metal salts form acid solutions because of deprotonation reactions. These are a kind of acid-base reaction so the mark is gained.

Part (c): When hydroxide precipitates are formed the sodium hydroxide is acting as a base not as a ligand.

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Examiner Tip

Make sure you understand the difference between deprotonation and ligand-exchange reactions.

Again a good answer but the reactions in part (b) and (c) were not understood.

(a)	Observe the appearance of **A**.	**Pale** green solid.	The cation ~~It~~ may be Fe^{2+} or Ni^{2+}	(1)
(b)	Measure the pH of a dilute aqueous solution of **A** using a pH meter.	The pH is 6.0.	The type of reaction that has occurred when **A** dissolved in water is ligand substitution ~~Substitution Hydrolysis~~	(1)
(c)	Add a few drops of dilute sodium hydroxide solution to a solution of **A**.	A green precipitate forms.	The sodium hydroxide is acting as ~~reactant~~ ligand The **formula** of the green precipitate is $Fe(OH)_2$ or $Ni(OH)_2$	(2)

(e)	Add excess sodium hydroxide solution to a sample of the green precipitate formed in (c).	The green precipitate does not dissolve.	It is not Cr^{3+} The cation is Fe^{2+}	(1)

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Examiner Comments

In part (a), it is perfectly acceptable to suggest that the pale green salt might contain Ni^{2+}.
In both parts (b) and (c) the reaction was wrongly identified as ligand exchange.

Part (e) is particularly well answered - the lack of amphoteric behaviour does indeed rule out Cr^{3+}.

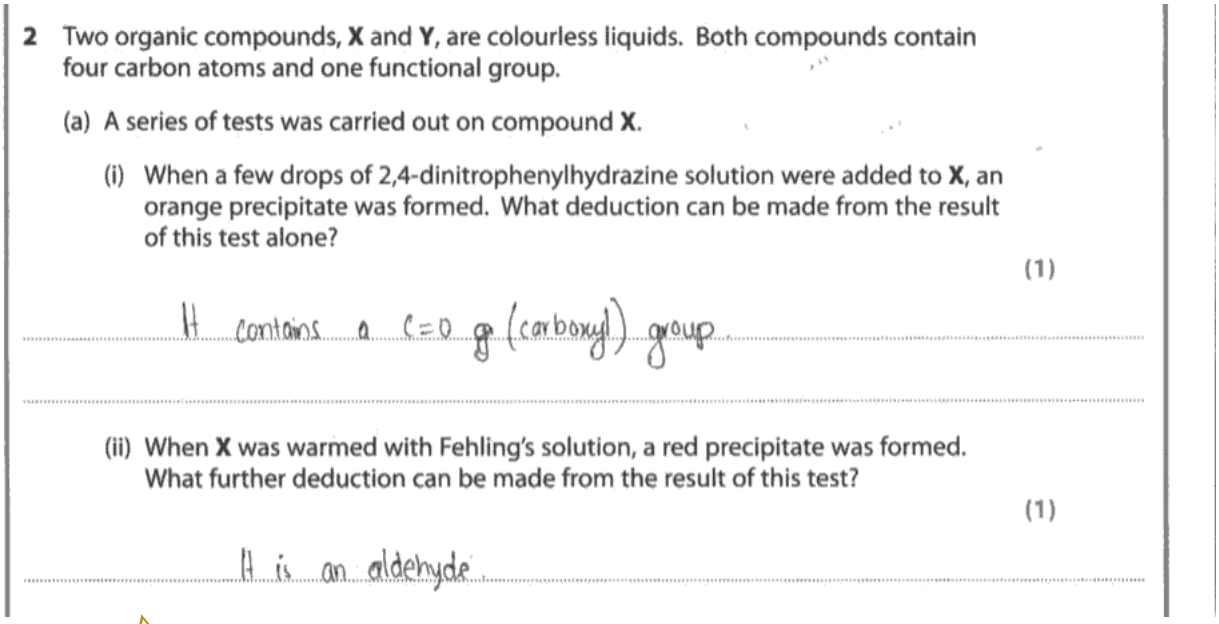
ResultsPlus
Examiner Tip

Make sure you understand the difference between deprotonation and ligand exchange reactions.

Question 2 (a)

This was generally very well answered.

One mark lost through an incorrect name.



2 Two organic compounds, **X** and **Y**, are colourless liquids. Both compounds contain four carbon atoms and one functional group.

(a) A series of tests was carried out on compound **X**.

(i) When a few drops of 2,4-dinitrophenylhydrazine solution were added to **X**, an orange precipitate was formed. What deduction can be made from the result of this test alone?

(1)

It contains a C=O gp (carboxyl) group.

(ii) When **X** was warmed with Fehling's solution, a red precipitate was formed. What further deduction can be made from the result of this test?

(1)

It is an aldehyde

ResultsPlus
Examiner Comments

Part (a): A good answer is spoiled by the use of an incorrect word - "carboxyl". "Carbonyl" is the correct name for the functional group.

ResultsPlus
Examiner Tip

Give either a name or a formula - whichever you are most certain is correct. If you give both, both must be correct.

In this example the candidate fails to appreciate that the test is for the carbonyl group.

2 Two organic compounds, **X** and **Y**, are colourless liquids. Both compounds contain four carbon atoms and one functional group.

(a) A series of tests was carried out on compound **X**.

(i) When a few drops of 2,4-dinitrophenylhydrazine solution were added to **X**, an orange precipitate was formed. What deduction can be made from the result of this test alone?

(1)

ketone present.

(ii) When **X** was warmed with Fehling's solution, a red precipitate was formed. What further deduction can be made from the result of this test?

(1)

Aldehyde present

ResultsPlus
Examiner Comments

In part (i) the positive test shows that the compound could be a ketone **or an aldehyde**.

ResultsPlus
Examiner Tip

Learn the organic functional group tests.

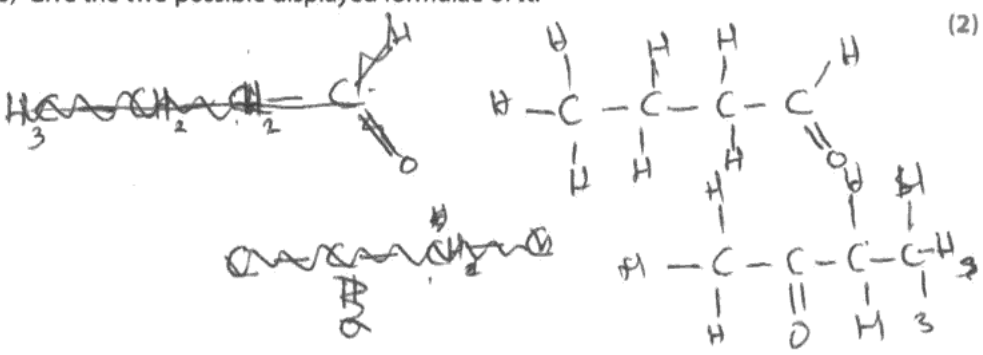
Question 2 (b)

This was well answered, though some candidates drew a ketone structure and a few wrote the same structure twice with different bond angles!

One correct and one wrong structure.

(b) Give the two possible displayed formulae of **X**.

(2)



ResultsPlus
Examiner Comments

The second formula shows a ketone not an aldehyde.

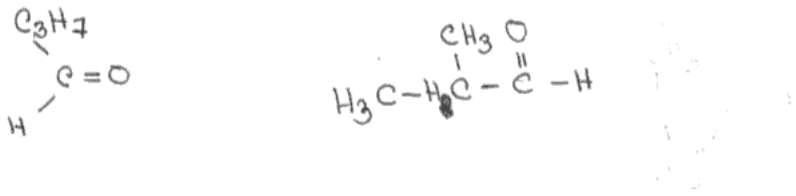
ResultsPlus
Examiner Tip

Check that your formulae have the correct functional groups.

One mark lost because the formula is ambiguous.

(b) Give the two possible displayed formulae of **X**.

(2)



ResultsPlus
Examiner Comments

The first formula includes a C_3H_7 group which could be joined to the rest of the molecule by an end carbon atom or the middle carbon atom. This is ambiguous so loses the mark.

ResultsPlus
Examiner Tip

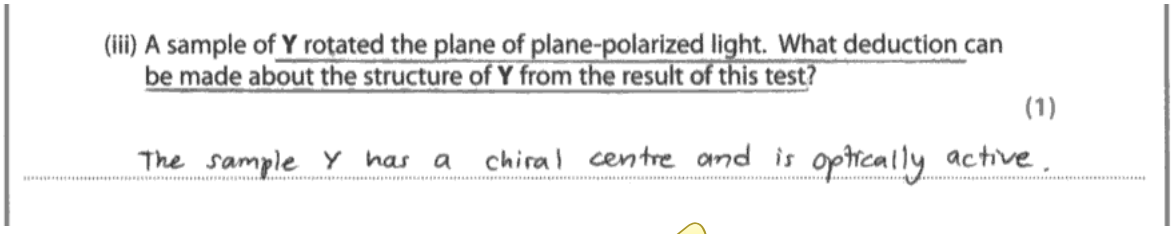
When asked for a displayed formula, show **all** the bonds and **all** the atoms.

Question 2 (c) (iii)

Most candidates appreciated that the molecule had a chiral centre. This could be expressed in a variety of ways.

It was not enough to simply say that it was optically active, since this merely repeats the information given in the question.

Note that it cannot be a racemic mixture as this would not be optically active.



(iii) A sample of **Y** rotated the plane of plane-polarized light. What deduction can be made about the structure of **Y** from the result of this test?

(1)

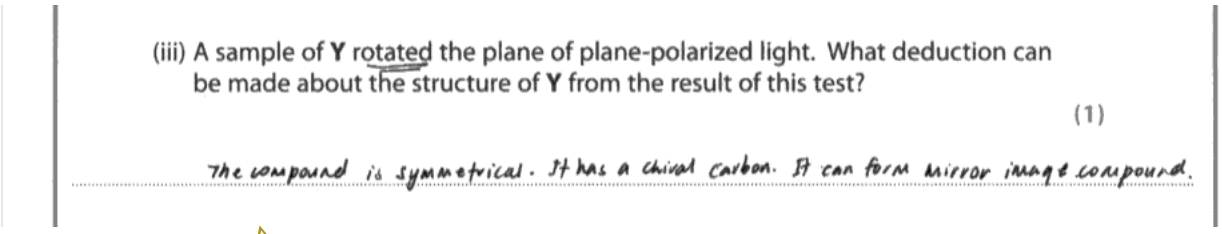
The sample Y has a chiral centre and is optically active.

ResultsPlus
Examiner Comments

Statement of "chiral centre" scores the mark.

ResultsPlus
Examiner Tip

Knowing the correct terminology can make your answers clear and succinct.



(iii) A sample of **Y** rotated the plane of plane-polarized light. What deduction can be made about the structure of **Y** from the result of this test?

(1)

The compound is symmetrical. It has a chiral carbon. It can form mirror image compound.

ResultsPlus
Examiner Comments

A potentially good answer is spoiled by the candidate stating that the molecule is symmetrical - if it was symmetrical, it could not be chiral.

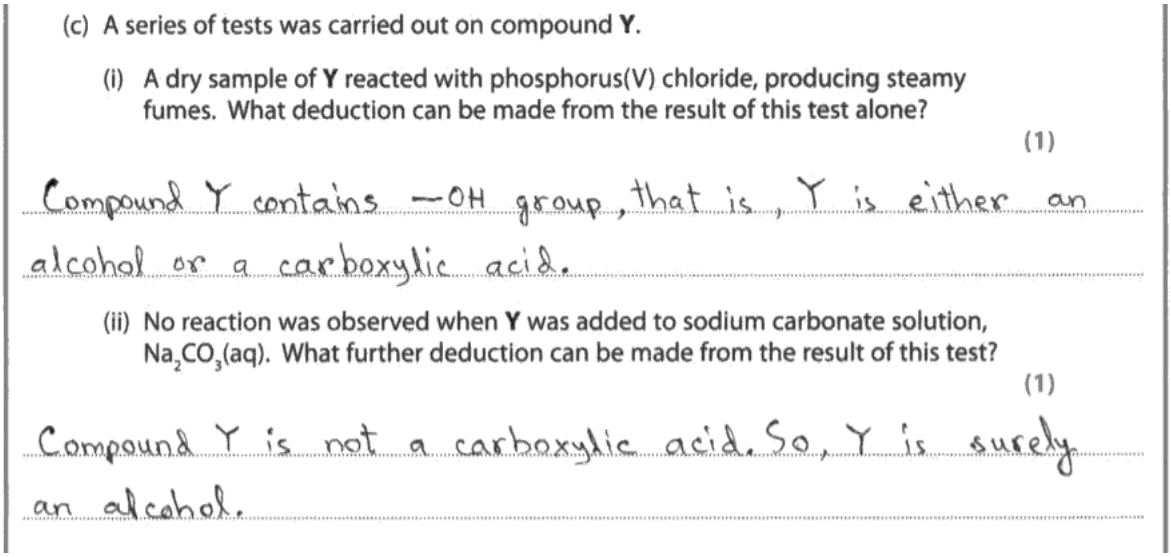
ResultsPlus
Examiner Tip

If you include several points in a one mark question, they all have to be correct. It is better to limit yourself to the central point you wish to communicate to the examiner.

Question 2 (c) (i)-(ii)

Well answered, though a few candidates threw away the second mark by simply saying that Y contains OH, which is true of alcohols and carboxylic acids.

An excellent answer.



(c) A series of tests was carried out on compound **Y**.

(i) A dry sample of **Y** reacted with phosphorus(V) chloride, producing steamy fumes. What deduction can be made from the result of this test alone?

(1)

Compound Y contains –OH group, that is, Y is either an alcohol or a carboxylic acid.

(ii) No reaction was observed when **Y** was added to sodium carbonate solution, $Na_2CO_3(aq)$. What further deduction can be made from the result of this test?

(1)

Compound Y is not a carboxylic acid. So, Y is surely an alcohol.

ResultsPlus
Examiner Comments

The candidate clearly understands that the first test is not specific for alcohol or carboxylic acid but that the second test enables them to be differentiated.

ResultsPlus
Examiner Tip

Try to express your answers clearly and logically like these.

Incorrect terminology loses a mark.

(c) A series of tests was carried out on compound **Y**.

(i) A dry sample of **Y** reacted with phosphorus(V) chloride, producing steamy fumes. What deduction can be made from the result of this test alone?

(1)

Y contain ~~oh group~~ hydroxide group

(ii) No reaction was observed when **Y** was added to sodium carbonate solution, $Na_2CO_3(aq)$. What further deduction can be made from the result of this test?

(1)

~~Y is ketone tertiary alcohol alcohol~~

Y is not carboxylic acid

ResultsPlus
Examiner Comments

"Hydroxide" is the name of the OH^- ion, "hydroxyl" is the correct name for a covalent bonded -OH group.

ResultsPlus
Examiner Tip

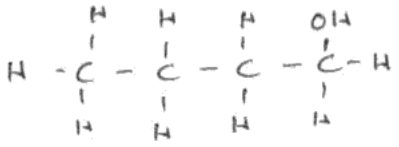
Learn the correct terminology.

Question 2 (c) (iv)

Well answered, though a few candidates gave the primary or the tertiary alcohol - neither of which is chiral.

(iv) Use your answers to parts (i), (ii) and (iii), and the fact that each molecule of **Y** contains four carbon atoms, to deduce the displayed formula of **Y**.

(1)



ResultsPlus
Examiner Comments

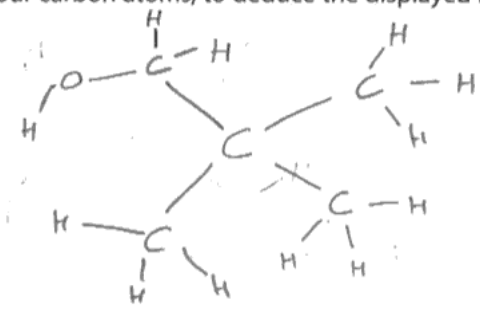
This is butan-1-ol which is not chiral.

ResultsPlus
Examiner Tip

For a chiral molecule, check that at least one carbon has four different groups attached.

(iv) Use your answers to parts (i), (ii) and (iii), and the fact that each molecule of **Y** contains four carbon atoms, to deduce the displayed formula of **Y**.

(1)



ResultsPlus
Examiner Comments

This alcohol has five carbon atoms and is not chiral.

ResultsPlus
Examiner Tip

Read the question.

Question 2 (c) (v)

The correct colour and physical state of the product was required.

(v) Describe what you would expect to **see** if a sample of compound **Y** was added to iodine, I_2, in alkaline conditions.

(1)

Yellow solution will be formed.

ResultsPlus
Examiner Comments

The product is insoluble and therefore forms a precipitate, so "solution" is incorrect.

ResultsPlus
Examiner Tip

When asked to describe a product, give the colour and the state.

(v) Describe what you would expect to **see** if a sample of compound **Y** was added to iodine, I_2, in alkaline conditions.

(1)

White precipitate

ResultsPlus
Examiner Comments

The precipitate is yellow, not white.

ResultsPlus
Examiner Tip

Learn the results of standard tests.

Question 3 (a) (i)-(ii)

The demanding calculations in this question were generally very well done. However, a surprising number of candidates failed to round the answer in part (ii) to two significant figures. Others truncated intermediate answers to only one significant figure, causing their final answers to be very inaccurate.

(ii) A student obtained 2.97 g of 2-ethanoylaminobenzoic acid from 4.00 g of 2-aminobenzoic acid. Calculate the percentage yield obtained by this student. Give your answer to **two** significant figures.

(3)

① ∴ no. of moles of 2-amino benzoic acid = no. of moles of 2-ethanoyl amino benzoic acid.

$= \frac{\text{mass}}{\text{f.mass}} = \frac{4}{137} = 0.0292$ moles

② ∴ Mass of 2-ethanoyl amino benzoic acid = $0.0292 \times 179 = 5.226$ g.
This is the theoretical yield. $= 5.238$

③ ∴ % yield = $\frac{2.97}{5.23} \times 100 = 56.8\%$

ResultsPlus
Examiner Comments

A good answer, but one mark is thrown away by failing to round to two significant figures.

ResultsPlus
Examiner Tip

Read the question.

(ii) A student obtained 2.97 g of 2-ethanoylaminobenzoic acid from 4.00 g of 2-aminobenzoic acid. Calculate the percentage yield obtained by this student. Give your answer to **two** significant figures.

relative molecular mass of 2-ethanoylaminobenzoic(3)acid
= 102 + 12 + 16 + 12 + 1 = 143.

theoretical yield = $143 \times 0.02919708 = 4.1752\text{g}$

$\therefore$ % yield = $\frac{2.97}{4.1752} \times 100\% = 71.1\%$

ResultsPlus
Examiner Comments

Part (a) is fully correct but in part (b) the M_r of the product is wrongly calculated and then the final answer is not given to two significant figures - so two marks are lost.

ResultsPlus
Examiner Tip

Be careful with significant figures.

Note that if the only error had been the M_r of the product, two marks could still be gained even though the final answer would have been wrong. This is why it is important to show your workings.

Question 3 (b) (i)

Most candidates appreciated that the ethanoic anhydride was used in excess to ensure that all the 2-aminobenzoic acid reacts.

Some lost the mark by stating that **all** the reactants are used up - which is not true of the excess ethanoic anhydride.

(b) (i) When this experiment is carried out, the actual volume of ethanoic anhydride used is greater than that calculated in (a). Suggest why this is so.

(1)

This ensures that all the 2-aminobenzoic acid has reacted.

ResultsPlus
Examiner Comments

A succinct correct answer.

ResultsPlus
Examiner Tip

Answers often do not need to be long-winded. Try to address the main issue without getting side-tracked.

(b) (i) When this experiment is carried out, the actual volume of ethanoic anhydride used is greater than that calculated in (a). Suggest why this is so.

(1)

To make sure that ethanoic anhydride is in excess.

ResultsPlus
Examiner Comments

The answer simply repeats the information in the question, so does not score.

ResultsPlus
Examiner Tip

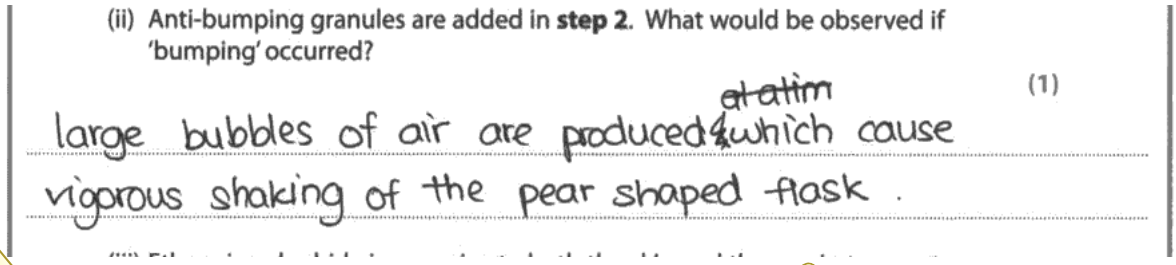
Rephrasing the question will not score marks - think about the reasons behind the information given.

Question 3 (b) (ii)

Many answers were too vague to gain any credit.

It was not enough to say that bubbles are formed - any boiling liquid will produce bubbles. Without anti-bumping granules the bubbles will be **large** and may cause liquid to be lost when it splashes out of the top of the condenser.

Some candidates incorrectly stated that the bubbles were made of air rather than the vapour of the reactants.



(ii) Anti-bumping granules are added in **step 2**. What would be observed if 'bumping' occurred?

(1)

large bubbles of air are produced ~~at atim~~ which cause vigorous shaking of the pear shaped flask .

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Examiner Comments

A promising answer - "large bubbles" would indeed be formed, but they are bubbles of the vapour of the reactants, not of air - so the mark is lost.

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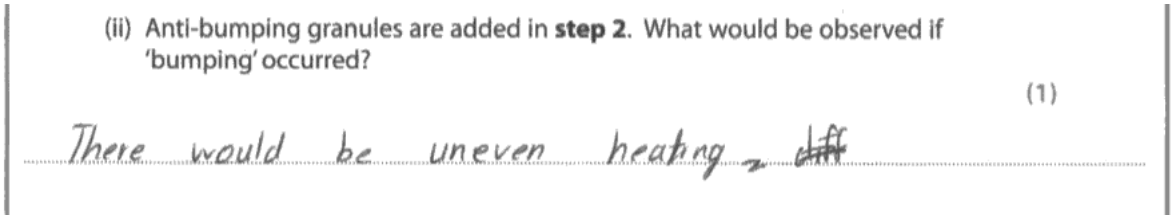
Examiner Tip

Think about the processes going on in a practical technique.



(ii) Anti-bumping granules are added in **step 2**. What would be observed if 'bumping' occurred?

(1)

There would be uneven heating ~~diff~~

ResultsPlus
Examiner Comments

"Uneven heating" is not quite enough to score. The point is that it is the boiling that is uneven without the anti-bumping granules.

ResultsPlus
Examiner Tip

Avoid vague statements - try to be specific.

Question 3 (b) (iii)

Most candidates appreciated the need for gloves but some thought that a face mask would be sufficient to prevent damage to the respiratory system. A simple mask would not absorb corrosive chemicals so this was not allowed. A fume cupboard is required.

(iii) Ethanoic anhydride is corrosive to both the skin and the respiratory system. Suggest **two** precautions to minimise the risks when using ethanoic anhydride, other than wearing eye protection and a lab coat.

(2)

- Use a mask
- Use gloves.

ResultsPlus
Examiner Comments

A face mask alone would not give adequate protection, so a mark is lost.

(iii) Ethanoic anhydride is corrosive to both the skin and the respiratory system. Suggest **two** precautions to minimise the risks when using ethanoic anhydride, other than wearing eye protection and a lab coat.

(2)

Wear gloves and use fumes cupboard.

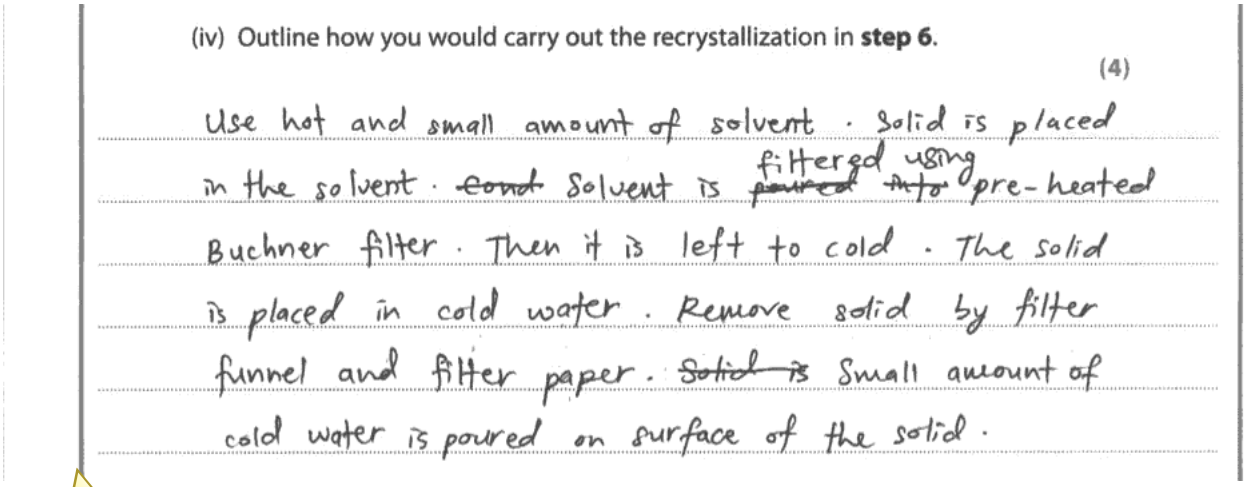
ResultsPlus
Examiner Comments

Despite the reference to "fume**s** cupboard", this scores the two marks.

Question 3 (b) (iv)

Many candidates were fully conversant with the recrystallization process and scored high marks.

Others had the correct processes in the wrong order - which simply would not work - so lost marks.



(iv) Outline how you would carry out the recrystallization in **step 6**.

(4)

Use hot and small amount of solvent. Solid is placed in the solvent. ~~cond~~ Solvent is ~~poured into~~ filtered using pre-heated Buchner filter. Then it is left to cold. The solid is placed in cold water. Remove solid by filter funnel and filter paper. ~~Solid is~~ Small amount of cold water is poured on surface of the solid.

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Examiner Comments

Almost all correct, but the final product has to be dried.

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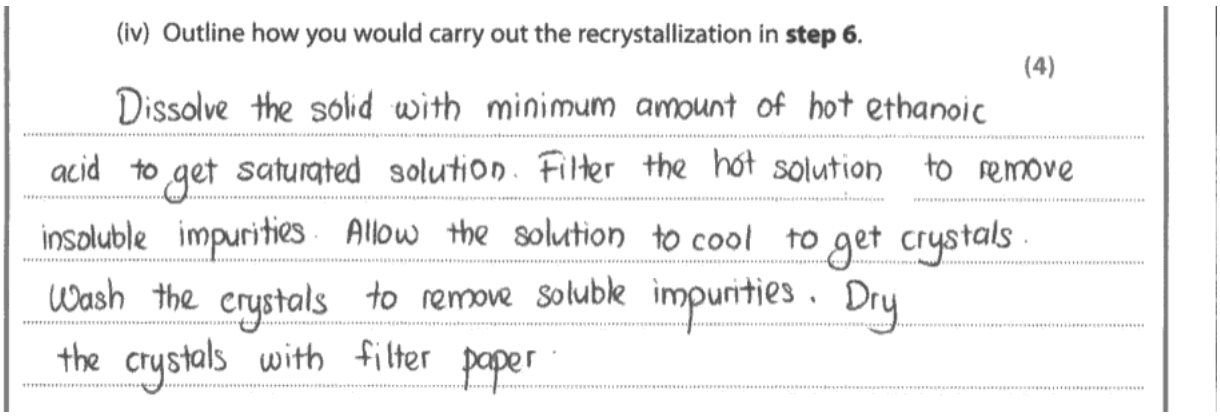
Examiner Tip

A pure product must be dry.



(iv) Outline how you would carry out the recrystallization in **step 6**.

(4)

Dissolve the solid with minimum amount of hot ethanoic acid to get saturated solution. Filter the hot solution to remove insoluble impurities. Allow the solution to cool to get crystals. Wash the crystals to remove soluble impurities. Dry the crystals with filter paper.

ResultsPlus
Examiner Comments

Almost all correct but the filtration to separate the crystals before they are washed and dried has been omitted.

ResultsPlus
Examiner Tip

Imagine you are carrying out the process in the lab. - then you won't leave steps out.

Question 3 (b) (v)

Many answers simply referred to "transfer errors" without giving details. This was not enough to score; one specific source of product loss was required for the mark. Disappointingly few candidates cited the likeliest source of error - product remaining dissolved in the saturated solution after crystallization.

(v) Suggest a reason why the recrystallization will slightly reduce the yield of 2-ethanoylaminobenzoic acid.

(1)

2 ethanoylaminobenzoic acid may remain in solution.

ResultsPlus
Examiner Comments

The best answer - this is the major source of product loss.

ResultsPlus
Examiner Tip

A short clear answer will get the marks.

(v) Suggest a reason why the recrystallization will slightly reduce the yield of 2-ethanoylaminobenzoic acid.

(1)

Loss of matenals during transfer. For example, during proiess of filtration.

ResultsPlus
Examiner Comments

This answer is too vague to score. The candidate needs to explain how product is lost during filtration.

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Examiner Tip

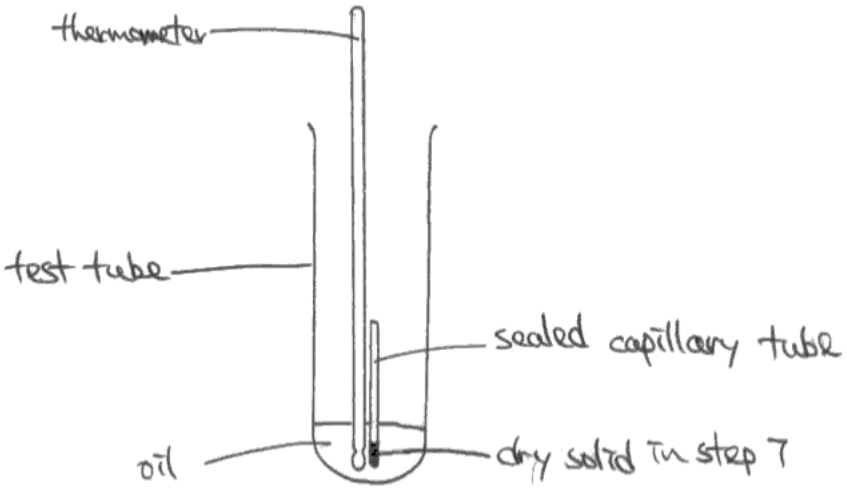
Don't be vague.

Question 3 (b) (vi)

Quite well done but many candidates suggested that a water bath be used to produce the high temperature required to melt the product. It is very unlikely that such a large molecule, capable of inter-molecular hydrogen bonding, would have such a low melting point - so a mark was lost. An oil or sand bath is required or an electrically heated metal block.

(vi) Draw a labelled diagram of the apparatus that could be used to find the melting temperature of the dry solid in **step 7**.

(2)



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Examiner Comments

A clear correct answer.

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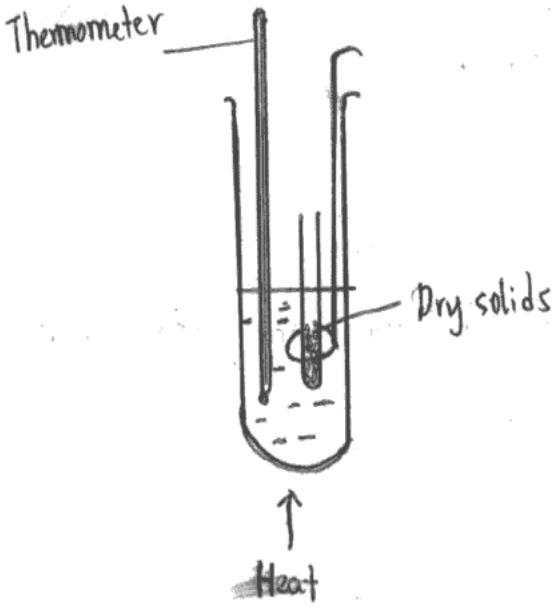
Examiner Tip

To get the marks, label clearly all the components of the apparatus.

(2)



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Examiner Comments

The apparatus is correct but the liquid used is not specified which loses the second mark.

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Examiner Tip

Label all the components of the apparatus.

Question 3 (b) (vii)

Generally well answered, however, some candidates confused 'a narrow melting point range (sharp melting point)' with a small difference between the literature and the measured value.

Others said that the measured value should be compared with a "theoretical" value but did not say how the "theoretical" value could be obtained. Reference to a data source was essential for the mark.

(vii) State **two** ways you would use the results from (vi) to check the identity and purity of the product.

(2)

It ~~should~~ The melting point should match to the one in the data booklet. check for compound with similar melting point.

ResultsPlus
Examiner Comments

One mark is gained for the comparison with the data book value but there is no reference to a "sharp" melting point so the second mark is lost.

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Examiner Tip

A two mark question usually requires two separate points in the answer.

(vii) State **two** ways you would use the results from (vi) to check the identity and purity of the product.

(2)

check the melting and boiling Point of ~~the the Pure~~ obtained Product with the Pure sample of the Product. if both has significantly very less difference. then the Product is Pure.

(Total for Question 3 = 19 marks)

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Examiner Comments

The candidate appreciates that the melting temperature must be compared with that of the pure product, but does not explain how this is to be found, so loses the mark. Reference to a sharp melting point is also missing.

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Examiner Tip

If you need data, explain how you would find it.

Question 4 (a)

Most candidates appreciated the purpose of a trial titration however, a few wrongly thought that it was to test the effectiveness of the apparatus and the method.

(a) Explain why a trial titration (titration 1) is carried out.

(1)

To check if the right materials and products were being used, more accuracy

ResultsPlus
Examiner Comments

This completely misunderstands the purpose of the trial run.

ResultsPlus
Examiner Tip

When you do practical work, make sure you understand the purpose of the operations you perform.

(a) Explain why a trial titration (titration 1) is carried out.

(1)

To act as a range finder so that the rest of the titrations can be carried out with greater accuracy. To find an approximate of how much volume of solution is required to reach end point.

ResultsPlus
Examiner Comments

An excellent answer, the candidate fully understands the purpose of the trial run.

ResultsPlus
Examiner Tip

When doing practical work, make sure you understand the reason for the operations you carry out.

Question 4 (b) (i)

Generally very well answered.

A few candidates expressed the 19.90 cm^3 as 19.9 cm^3 and lost a mark.

A few used only two of the three concordant results and so lost a mark.

Titration number	1 (trial)	2	3	4
Burette reading (final) / cm^3	21.45	41.35	21.95	2·15
Burette reading (initial) / cm^3	1.20	21.45	1·95	21.95
Volume of $Fe^{2+}(aq)$ used / cm^3	17·875	19·9	20.00	19.80
Titre used to calculate mean (✓)		✓	✓	✓

(a) Explain why a trial titration (titration 1) is carried out.

(1)

To ensure that the reading is accurate.

(b) (i) Complete the table and indicate with a tick (✓) those titres most suitable for calculating a mean titre.

Use the titres you have chosen to calculate the mean titre.

(4)

$$= \frac{19.9 + 20.0 + 19.8}{3}$$

$$= 19.9$$

Mean titre = 19.9 cm^3

ResultsPlus
Examiner Comments

A potentially good answer spoiled by the failure to express the second titre to two decimal places in run 2 and a silly slip in calculating the final burette reading in run 4.

ResultsPlus
Examiner Tip

Always give burette readings and titres to two decimal places and check your arithmetic.

Titration number	1 (trial)	2	3	4
Burette reading (final) / cm^3	21.45	41.35	21.95	41.75
Burette reading (initial) / cm^3	1.20	21.45	1.95	21.95
Volume of $Fe^{2+}(aq)$ used / cm^3	20.25	19.9	20.00	19.80
Titre used to calculate mean (✓)	X	√	√	X

(a) Explain why a trial titration (titration 1) is carried out.

(1)

The burette is not completely empty.

(b) (i) Complete the table and indicate with a tick (✓) those titres most suitable for calculating a mean titre.

Use the titres you have chosen to calculate the mean titre.

(4)

mean titre = $\frac{19.9 + 20}{2}$

= 19.95 cm^3

Mean titre = 19.95 cm^3

ResultsPlus
Examiner Comments

Again, a mark is lost for expressing the titre in run 2 to only one decimal place and another is lost because the titre in run 4 is not marked as concordant.

ResultsPlus
Examiner Tip

All results within 0.20 cm^3, except for the rough titre, are concordant and should be included in the calculation of the average titre.

Question 4 (b) (ii)

This question was very well answered. Most candidates were clearly familiar with this type of calculation from titration results.

(ii) Use the equation below, and your mean titre, to calculate the concentration of the sodium dichromate(VI) solution, in mol dm^{-3}.

(3)

$$Cr_2O_7^{2-}(aq) + 6Fe^{2+}(aq) + 14H^+(aq) \rightarrow 2Cr^{3+}(aq) + 6Fe^{3+}(aq) + 7H_2O(l)$$

orange green

The no. of mole of $Fe^{2+}_{(aq)} = \left(\frac{19.9}{1000}\right)(0.05) = 9.95 \times 10^{-4}$ mol

The mole ratio of $Cr_2O_7^{2-} : Fe^{2+}$

$= 1 : 6$.

The no. of mole of $Cr_2O_7^{2-} = \frac{9.95 \times 10^{-4}}{6} = 1.658 \times 10^{-4}$ mol

The concentration of the sodium dichromate (VI) solution

$= 1.658 \times 10^{-4} \div \frac{20}{1000}$

$= 8.29 \times 10^{-3}$ mol dm^{-3}

ResultsPlus
Examiner Comments

An excellent answer, the calculation is correct and set out in logical steps.

ResultsPlus
Examiner Tip

Try to set out your calculations like this - showing what is calculated in each step.

(ii) Use the equation below, and your mean titre, to calculate the concentration of the sodium dichromate(VI) solution, in mol dm^{-3}.

(3)

$$Cr_2O_7^{2-}(aq) + 6Fe^{2+}(aq) + 14H^+(aq) \rightarrow 2Cr^{3+}(aq) + 6Fe^{3+}(aq) + 7H_2O(l)$$

orange green

~~No. of moles of Fe~~ ~~Concentration of Fe^{2+}~~

No. of mol of Fe^{2+} ions $= \frac{(\text{conc})(\text{vol})}{1000}$

$= \frac{(0.05)(20)}{1000}$

$= 0.001$ mol

6 mol $Fe^{2+} \rightarrow$ 1 mol $Cr_2O_7^{2-}$

1 mol $Fe^{2+} \rightarrow 0.167$ mol $Cr_2O_7^{2-}$

0.001 mol $Fe^{2+} \rightarrow 1.67 \times 10^{-4}$ mol Cr_2O_7

$1.67 \times 10^{-4} = \frac{(M)(20)}{1000}$

Concentration of $Cr_2O_7^{2-} = 8.35 \times 10^{-3}$ mol #

ResultsPlus

Examiner Comments

The calculation is essentially correct but the result of the first step has been rounded to only one significant figure which makes the following results very inaccurate. One mark is lost for this inaccuracy.

ResultsPlus

Examiner Tip

In all intermediate steps in a calculation, work to one more significant figure than you will use for the final answer.

Question 4 (c)

Many candidates failed to appreciate that the error in the burette reading must be doubled since each titration requires two readings to be taken.

A few students used the wrong titre value and lost a mark.

(c) Assuming the accuracy of the burette is ±0.05 cm^3 each time the burette is read, calculate the % error of the titre in **titration 3**.

(1)

$$\%\ \text{Error} = \frac{0.05}{20} \times 100\ \%$$

$$= 0.25\ \%$$

ResultsPlus
Examiner Comments

The burette error is not doubled.

ResultsPlus
Examiner Tip

When two readings must be taken, for example when using a balance to measure the mass of a sample or a burette to measure the volume, each could contribute to the error so the error value must be doubled.

(c) Assuming the accuracy of the burette is ±0.05 cm^3 each time the burette is read, calculate the % error of the titre in **titration 3**.

(1)

$$\frac{2 \times 0.05}{20} \times 100 = 0.5\ \%$$

ResultsPlus
Examiner Comments

This is the correct calculation.

Question 4 (d)

Many answers were too vague to score. The point is that the indicator makes the colour change at the end-point sharper or clearer to see.

(d) Suggest one reason why the indicator diphenylamine is needed, even though the solution in the titration flask changes colour from orange to green when no indicator is used.

(1)

To give a more accurate reading of when the titration reaches its end point.

ResultsPlus
Examiner Comments

This answer does not explain why the titre would be more accurate, so does not score.

ResultsPlus
Examiner Tip

Always explain the reasons behind your answers.

(d) Suggest one reason why the indicator diphenylamine is needed, even though the solution in the titration flask changes colour from orange to green when no indicator is used.

(1)

Fe^{2+} ions is also green. The colour change at the end point is not clear and hence diphenylamine is added to provide a more distinct colour change.

ResultsPlus
Examiner Comments

A good answer which makes the function of the indicator clear.

ResultsPlus
Examiner Tip

When answering this type of question, imagine yourself carrying out the titration and think what the problems might be.

Question 4 (e)

Many candidates appreciated that the titre would be too high, but then failed to explain that this was a result of the air bubble in the burette at the beginning of the titration.

(e) A student carrying out one titration left an air bubble in the tip of the burette before taking the initial reading. This bubble was no longer present when the student took the final reading.

State and explain what effect, if any, this would have on the titre value. What effect would the use of this titre have on the calculated concentration of sodium dichromate(VI)?

(3)

The titre value is read wrongly. This will eventually cause the calculated concentration of sodium dichromate (VI) inaccurate. This will also cause the percentage error of the titre increases.

ResultsPlus
Examiner Comments

This answer is too vague to score any marks. There is no indication of why the titre would be inaccurate and no discussion of whether the titre would be increased or decreased as a result.

ResultsPlus
Examiner Tip

Don't be vague - try to think through the exact effect of an error like this.

(e) A student carrying out one titration left an air bubble in the tip of the burette before taking the initial reading. This bubble was no longer present when the student took the final reading.

State and explain what effect, if any, this would have on the titre value. What effect would the use of this titre have on the calculated concentration of sodium dichromate(VI)?

(3)

The titre value would have been more than the actual value without the air bubble, since the empty space left by the air bubble would be measured as the volume used in the titration. The calculated concentration of Sodium Dichromate (VI) would be larger than the actual value.

(Total for Question 4 = 13 marks)

ResultsPlus
Examiner Comments

An excellent answer. The candidate fully understands the effect of the bubble.

ResultsPlus
Examiner Tip

Try to give answers like this with a clear logical explanation of effect of the suggested error.

Paper Summary

Based on their performance on the paper, candidates are offered the following advice:

- Make sure you can explain the reasons for the steps in standard techniques such as titrations and recrystallization.
- Explain less familiar techniques.
- Make sure you understand the importance of using an appropriate number of significant figures in the various steps of calculations to ensure the final answer is accurate.
- Learn the tests that distinguish between functional groups and their position in molecules. e.g. primary, secondary and tertiary alcohols.

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